

80 micro

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EXPANDED MEMORY

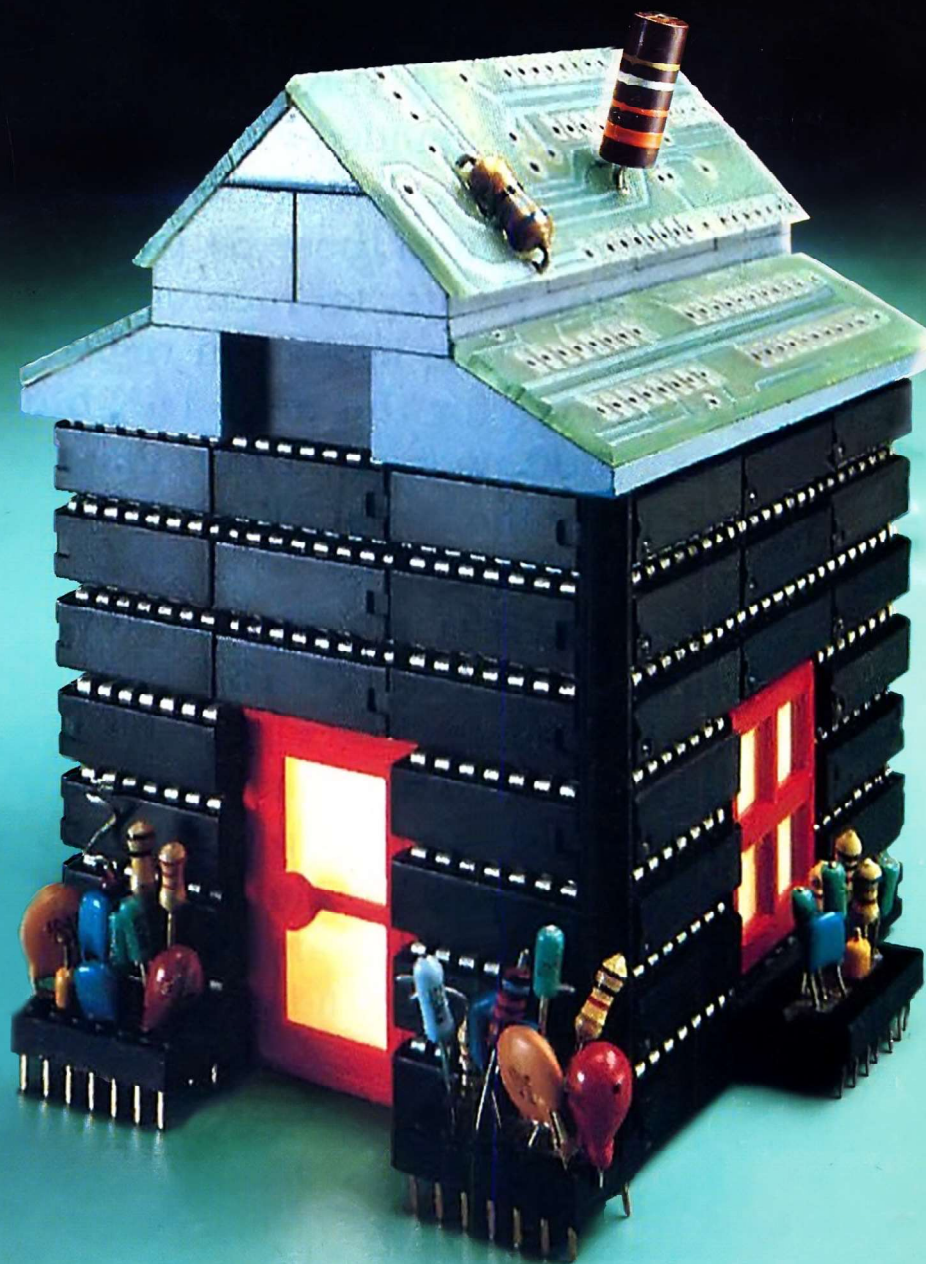
**How Your 1000
Can Break 640K**

**How to Manage
Floppy Files**

**Exclusive!
Upgrade
Your 4
To 320K!**

**The Pitfalls
Of Mail Order**

**Top Shareware
For Business**



All the Way to 320K

Gain four 64K memory banks with this do-it-yourself mod.

You can upgrade your Model 4 or 4P past its 128K memory "limit." By replacing the upper bank of 64K chips with 256K chips, you can have 320K of memory. You must change the circuitry to accommodate a 256-cycle refresh (a 128-cycle is normal) and to use the 256K chips as four switchable 64K banks. This article shows you how to do this and provides you with software to use the extra memory.

Ed. note: This project requires soldering skills and knowledge of the Model 4's circuitry. If you don't feel confident about performing the modification yourself, find someone who can do it for you.

Circuit Theory

The project requires two circuits, which you can most easily build on two separate boards. The first circuit is the refresh counter (see Figure 1), which is responsible for converting the Model 4's 128-cycle refresh circuit to generate the required 256-cycle refresh. Input pin 1 of U1 (74LS393) on the refresh-counter board connects to the active-high refresh signal generated by pin 6 of U87 (74F04) on the Model 4P's board, or pin 16 of U60 (74LS240) on the Model 4's board. This

signal also connects to pin 1 of U2 (74LS157) on the refresh-counter board. U1, a dual 4-bit counter, is wired to act as a single 8-bit counter, toggling its 2QD output every 128 refresh cycles. U2 is a quad two-to-one multiplexor.

On the refresh-counter board, the 2QD (pin 8) output of U1 connects to the 1B input of U2 (pin 3). The corresponding 1A input of U2 (pin 2) connects to the computer's dynamic RAM A7 line: it is pin 4 of U110 (74LS157) on the 4P, while on the Model 4 it is pin 9 of U63 (74157). The 1Y output of the refresh-counter multiplexor, pin 4 of U2, must connect back to where the computer's A7 line was going. On the 4P, the 1Y signal should connect to pin 8 of resistor pack RP1; on the Model 4, 1Y should connect to pin 8 of resistor pack RP4.

The printed circuit board trace between the computer's A7 line and the respective resistor pack must also be cut. On the 4P, the trace connects pin 4 of U110 (74LS157) to pin 8 of RP1. On the Model 4, the trace connects pin 9 of U63 (74157) to pin 8 of RP4. The new refresh-counter circuit now takes the place of this trace, providing the desired 256-cycle refresh for supporting 256K DRAMs.

Second Circuit

The second circuit, the bank-select circuit (see Figure 2), switches among the four 64K banks. As I will detail later, during an Out instruction to input/output (I/O) port zero, D0 and D1, the two low-order bits of the byte being output, are latched by U5, a 74LS75 latch. The latched bits are then applied to the 1A (pin 2) and 1B (pin 3) inputs of U6, a 74LS157 multiplexor. The output, 1Y (pin 4), is connected (via a 27-ohm resistor) to pin 1 of the 256K DRAMs. This pin, which is unused in 64K DRAMs, is used for address bits 9 and 18 in 256K DRAMs. Four unique values can be applied to address lines 9 and 18 by writing values whose two low-order bits range from zero to 3 to

System Requirements

Model 4/4P
64K RAM
Editor/assembler
Available on The Disk Series

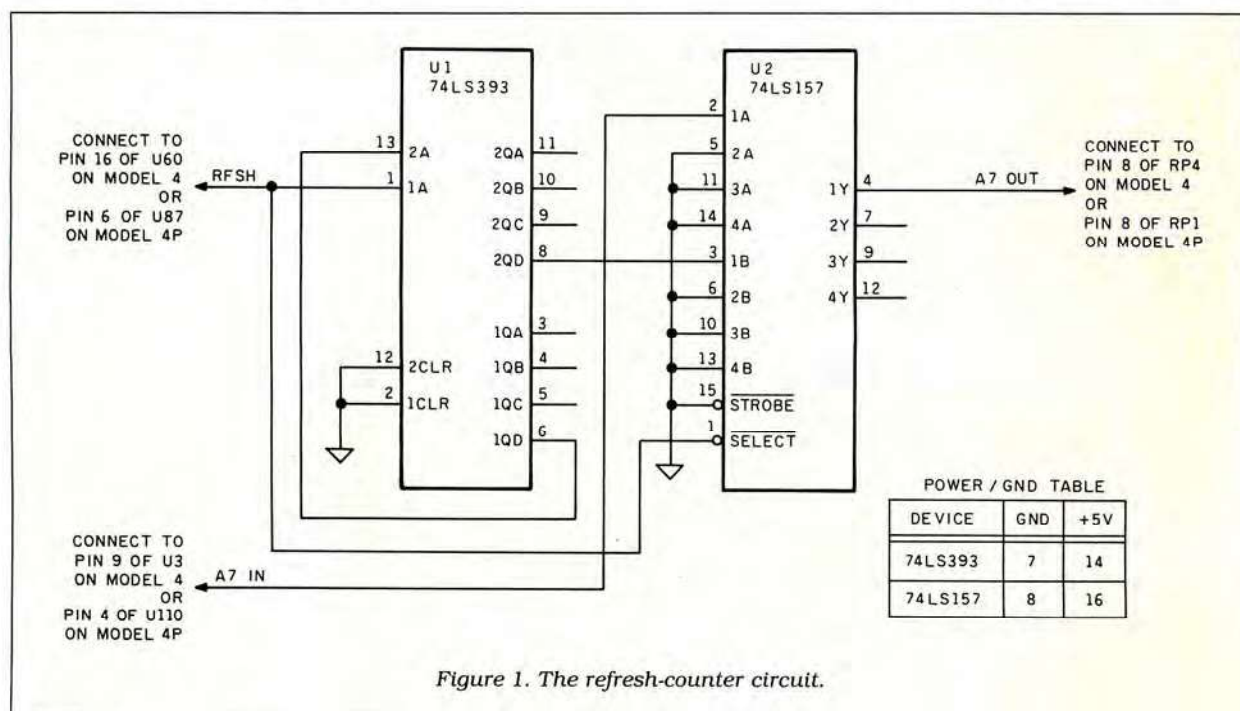
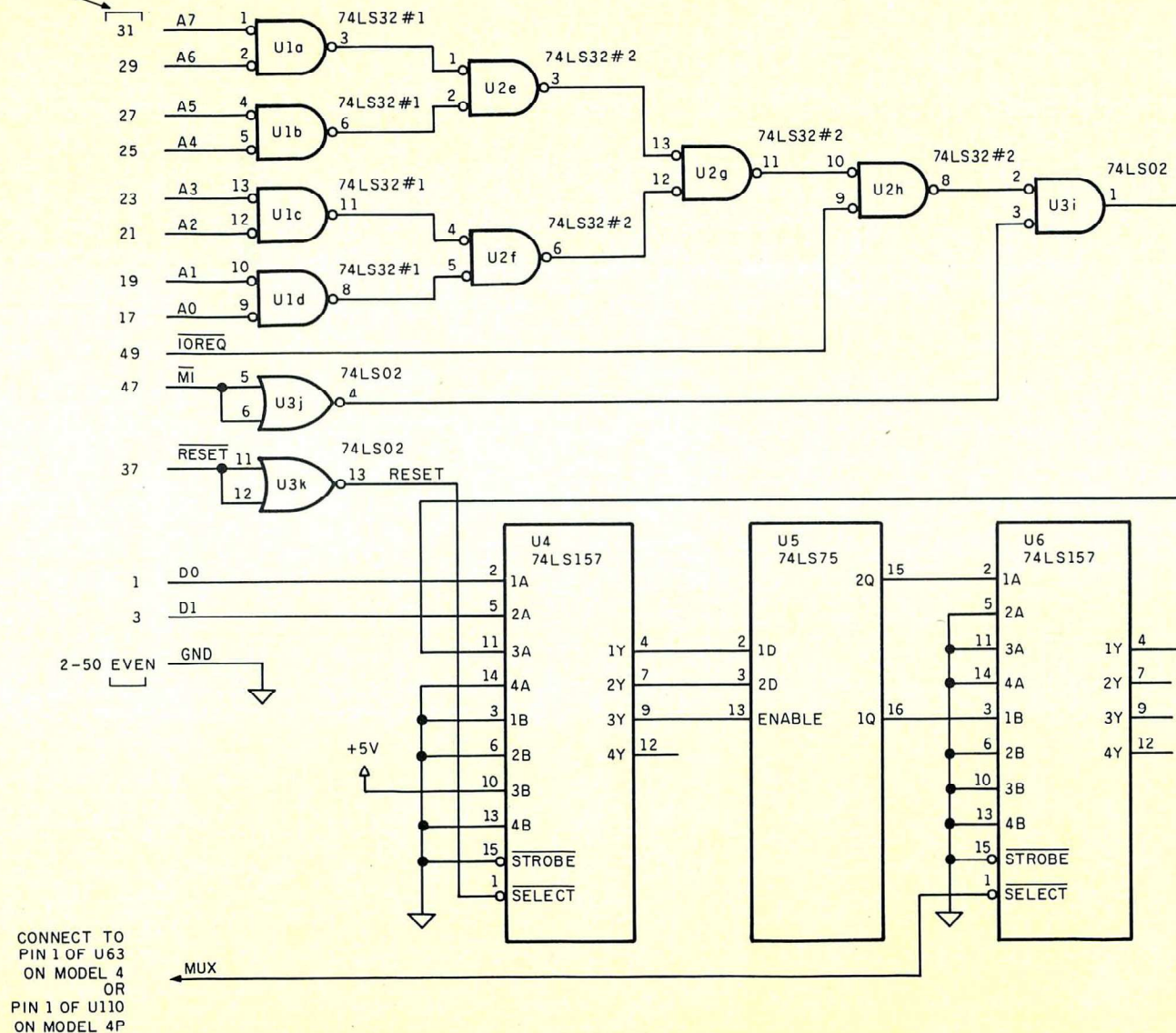


Figure 1. The refresh-counter circuit.

MODEL 4/4P 50-PIN
EXPANSION CONNECTOR



POWER/GND TABLE

DEVICE	GND	+5V
74LS32	7	14
74LS02	7	14
74LS157	8	16
74LS75	12	5

Figure 2. The bank-select circuit.

I/O port zero. This divides the 256K DRAMs into four 64K banks, one for each value. Each bank is accessed in the usual way by the Z80 using its 16 address lines.

Bank zero is automatically placed in context on reset or power-up.

Referring to Figure 2, gates A–J form a decoder to select the bank-select latch when writing to I/O port zero; the output

of the decoder goes high during a port zero write. The decoder output connects to the 3A input of a 74LS157 multiplexor (U4). The 1A and 2A inputs of the multiplexor are connected to the low-order data bus lines, D0 and D1, respectively.

During normal operation, the multiplexor select line (pin 1)—controlled by the system reset signal—causes the mul-

tiplexor to pass the 1A, 2A, and 3A input signals through to the 74LS75 latch (U5). Thus, when a port zero write occurs, the D0 and D1 bit values are latched into U5, selecting the desired 64K bank (one of four).

During reset, the alternate multiplexor "B" inputs are routed through to the U5 latch, because the active reset signal switches the multiplexor select input. The "B" multiplexor inputs are hardwired to ground (1B and 2B) and +5V written to the U5 latch. This effectively clears the latch, selecting the default 64K bank zero. After reset, software can again freely choose which 64K bank it wants to be active at any given time.

Requires Inputs

Because of the larger addressing space, 256K memory chips require two more address inputs than 64K memory chips. Since address lines on DRAMs are multiplexed—half latched during row-address-strobe (RAS) time and half latched during column-address-strobe (CAS) time—256K DRAMs need one more address pin than the 64K DRAMs normally found in the Model 4 and 4P systems. This extra pin is pin 1, which is unused on the 64K devices.

As described above, the 74LS75 latch in the bank-select circuit holds 2 bits that determine which of four 64K banks in the 256K of memory is to be selected. This is done by making the two 74LS75 latched bits the extra address bits required by the 256K DRAMs. These bits are passed through another 74LS157 multiplexor (U6) to provide the RAS/CAS multiplexing necessary to place the bits on the DRAM address pins at the appropriate times. Thus, the pin 1's on the Model 4/4P DRAM sockets must all be connected together and to the output of the U6 multiplexor to support the extra address line. As shown, a 27-ohm series resistor is used between the multiplexor and DRAM connection to minimize noise. The resistor value is not critical. The Model 4 uses 56-ohm resistors, while the 4P uses 27 ohms.

The select signal (pin 1) for the U6 multiplexor comes from pin 1 of U63 (74LS157) on the Model 4, and pin 1 of U110 (74LS157) on the 4P.

Building the Circuits

Start your construction by making the necessary trace cut on your computer's circuit board. On the Model 4, cut the trace between pin 9 of U63 (74LS157) and pin 8 of resistor pack RP4. On the 4P, cut the trace between pin 4 of U110 (74LS157) and pin 8 of resistor pack RP1. Be careful to cut the correct trace. It is also good practice to use an ohmmeter when you're done, to verify that a short no longer exists between the two points.

Once the cut is done, connect all the pin 1's of the pertinent DRAM sockets together, by wiring pin to pin. On the Model

Bank-Select Board

U1, U2	74LS32 quad 2 input Or gate	25¢
U3	74LS02 quad 2 input Nor gate	19¢
U4, U6	74LS157 quad two-line to one-line multiplexor	35¢
U5	74LS75 4-bit bistable latch	29¢

Refresh-Counter Board

U1	74LS393 dual 4-bit binary counter	79¢
U2	74LS157 quad two-line to one-line multiplexor	35¢

RAM

U1–U8	50256P-15 150-ns dynamic RAM (Hitachi)	\$3.29
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Miscellaneous Parts

Refresh-counter board (Radio Shack)	\$1
Bank-select board (Radio Shack)	\$2
Connector for external I/O bus (Radio Shack)	\$3*
Sockets (if desired)	10–30¢ each

*Type will vary. The Model 4P has a 50-pin edge connector; the Model 4 has a 50-pin plug.

Table. The chips used for Model 4/4P RAM expansion.

Program Listing. 256K Memdisk.

```

00100      TITLE      '256K MEMDISK'
00110      ;*****
00120      CR          EQU      0DH
00130      LF          EQU      0AH
00140      @BANK      EQU      66H
00150      @GTMOD      EQU      53H
00160      @GTDCT      EQU      51H
00170      @DSPLY      EQU      0AH
00180      @KEY        EQU      1
00190      @EXIT       EQU      16H
00200      @HIGH$      EQU      64H
00210      @GTDCB      EQU      52H
00220      ;*****
00230      ORG         3000H
00240      ;
00250      START:
00260          LD       HL,OPMSG      ;OPENING MESSAGE
00270          LD       A,@DSPLY      ;SHOW IT
00280          RST      28H
00290          LD       HL,OPMSG1
00300          LD       A,@DSPLY
00310          RST      28H
00320          LD       HL,OPMSG2
00330          LD       A,@DSPLY
00340          RST      28H
00350          LD       HL,OPMSG3
00360          LD       A,@DSPLY
00370          RST      28H
00380          LD       HL,OPMSG4
00390          LD       A,@DSPLY
00400          RST      28H
00410      KEY:
00420          LD       A,@KEY        ;GET ANSWER TO MESSAGE
00430          JP       NZ,KEY
00440          RES      5,A           ;U/C
00450          CP       'N'          ;ABORT ?
00460          JP       Z,EXIT        ;IF SO, THEN GO
00470          CP       'Y'          ;FORMAT?
00480          JP       NZ,DRIVEALT   ;NO- THEN JUST ALTER THE DRIVER
00490      ;
00500      FORMAT:
00510          CALL     FILLZ          ;FILL UPPER BANKS WITH ZEROES
00520          CALL     TABLES       ;ALTER DCT AND GAT FOR LARGER DRIVE
00530          JP       DRIVEALT      ;AND THEN ALTER THE DRIVE

```

Listing continued

4, the pertinent sockets are U85-U92. On the 4P, the sockets of interest are U153-U160.

Now construct the refresh circuit board, determining ahead of time where you will mount it. With the refresh circuit board in position, connect power and ground lines from your computer's board to the refresh board, to provide power for the chips.

Once you have connected the power

Your computer should be ready to accept 256K DRAMs, and kick you off to greater memories.

lines, connect the three signal wires that interface to the computer board. On the Model 4, the connections are to pin 16 of U60 (74LS240), pin 9 of U63 (74157), and pin 8 of RP4. On the 4P, the connections are to pin 6 of U87 (74F04), pin 4 of U110, and pin 8 of RP1. Once you make these connections, the refresh circuit installation is complete.

Finally, construct the bank-select circuit board, again predetermining where it will be mounted in your computer's cabinet. It is best to mount this board near the 50-pin expansion connector. With the board at or near its final installation site, connect power and ground to the bank-select board from a convenient location on your computer's circuit board.

Connect all signals that attach to the 50-pin expansion port; this should leave only two signals yet to be attached. Now connect pin 1 of U6 (74LS157) to the appropriate multiplexor signal connection on your computer's circuit board. This is to pin 1 of U63 (74157) on the Model 4, and pin 1 of U110 (74LS157) on the 4P.

At Last!

Finally, connect the open end of the 27-ohm resistor on the bank-select board to pin 1 of one of your computer's DRAM sockets that you wired earlier. The bank-select circuit board installation is now complete. Your computer should be ready to accept 256K DRAMs, and kick you off to greater memories!

The refresh counter was built on the Radio Shack board (catalog no. 276-159), a two-chip board perfect for the purpose. The bank-select board was built on a 4-inch-wide board (approximately), to fit in an internal slot above the main printed circuit board on the Model 4P. You might want to measure your machine to make

Listing continued

```
00540 ;
00550 FILLZ: LD A,(BUSE) ;PUT NEW XTENDED BANK IN CONTEXT
00560 OUT (0),A
00570 INC A ;LAST ONE DONE
00580 CP 5
00590 JP NC,BACK ;GO IF SO
00600 ;
00610 LD (BUSE),A ;NO, STORE NEXT BANK
00620 DI ;DISABLE INTERRUPTS
00630 LD BC,1 ;LOWER 1/2
00640 LD A,@BANK ;IN CONTEXT
00650 RST 28H
00660 PUSH BC ;SAVE OLD BANK
00670 CALL FILLER ;AND FILL WITH ZEROES
00680 LD BC,2 ;UPPER 1/2
00690 LD A,@BANK ;IN CONTEXT
00700 RST 28H
00710 CALL FILLER ;AND FILL WITH ZEROES
00720 POP BC ;GET BACK ORIGINAL BANK
00730 LD B,0
00740 LD A,@BANK
00750 RST 28H
00760 EI ;ENABLE INTERRUPTS
00770 JP FILLZ ;ROUND AGAIN
00780 ;
00790 BACK: LD A,0
00800 OUT (0),A ;ORIGINAL XTENDED BANK
00810 RET ;BACK
00820 ;
00830 FILLER: LD HL,8000H ;FILL UPPER 32K OF MEMORY WITH 0s
00840 LPI: LD A,0
00850 LD (HL),A
00860 INC HL
00870 INC HL
00880 INC HL
00890 LD A,H
00900 OR L
00910 JR NZ,LPI
00920 RET
00930 ;
00940 TABLES: LD A,0 ;XTENDED BANK 0
00950 OUT (0),A ;IN CONTEXT
00960 DI ;DISABLE INTERRUPTS
00970 LD C,1 ;LOWER 1/2
00980 LD A,@BANK ;IN CONTEXT
00990 RST 28H
01000 PUSH BC ;SAVE ORIGINAL BANK
01010 LD C,03H ;LOGICAL DRIVE #3
01020 LD A,@GTDCIT ;CHANGE MAX#CYL IN DCT
01030 RST 28H
01040 LD (1Y+6),037H ;55 CYLINDERS RELATIVE TO 0
01050 ;
01060 LD HL,92CCH ;CYLINDERS OVER 35 BYTE OF GAT
01070 LD A,015H ;CYLINDERS OVER 35
01080 LD (HL),A ;PUT IN
01090 ;
01100 LD HL,9202H ;FREE/ASSIGNED TABLE, LESS 1ST 2 BYTES
01110 LD A,0F8H ;ALL 3 GRANS FREE
01120 LD B,36H ;54 CYLS EXCEPTING BOOT AND DIR
01130 F1: LD (HL),A ;FILL
01140 INC HL
01150 DJNZ F1 ;54 BYTES WITH F8H
01160 ;
01170 LD HL,9202H ;AND COPY TO AVAIL/LOCKED OUT TABLE
01180 LD DE,9062H ;TO ADDRESS
01190 LD BC,05EH ;BYTES TO COPY
01200 LDIR ;DO IT
01210 ;
01220 POP BC ;GET BACK ORIGINAL BANK
01230 LD B,0
01240 LD A,@BANK
01250 RST 28H
01260 EI
01270 RET
01280 ;
01290 ;DRIVEALT: THIS SECTION INSTALLS THE MODIFICATIONS TO THE DRIVER, AND
01300 ;MODIFIES THE POINTER THAT KEEPS TRACK OF FREE SPACE IN THE DRIVER AREA
01310 DRIVEALT: LD DE,MODNAME ;GET POINTER TO MODULE HEADER (HL)
01320 LD A,@GTMOD ;AND DCB (DE)
01330 RST 28H
01340 JR NZ,NIST ;NO MODULE - GO
01350 LD (HDBL),HL ;SAVE MOD HDR ADDRESS
01360 INC HL ;HL=> ADDRESS OF LAST BYTE OF MODULE
01370 INC HL
01380 LD E,(HL) ;GET ADDRESS IN DE
01390 INC HL
01400 LD D,(HL)
01410 DEC HL ;RESTORE HL
01420 ;
01430 LD B,40H ;ADD 40H TO THE ADDRESS
01440 LOOPX: INC DE
01450 DJNZ LOOPX
01460 ;
01470 LD (HL),E ;PUT NEW END INTO MODULE
01480 INC HL
```

Listing continued

Listing continued

```

01550      LD      (HL),D
01560      ;
01570      ;THE FOLLOWING SECTION UPDATES THE SYSTEM POINTER THAT KEEPS TRACK
01580      ;OF THE NEXT FREE LOCATION IN THE DRIVER AREA (STORED AT KIDCB-2).
01590      ;
01600      PUSH    DE      ;SAVE ADDRESS OF LAST BYTE OF MODULE
01610      LD      D,'I'
01620      LD      E,'K'
01630      LD      A,@GTDCB
01640      RST     28H
01650      DEC     HL
01660      DEC     HL      ;HL=>KIDCB-2 = POINTER TO
01670      ;FIRST BYTE OF FREE MEMORY
01680      PUSH    HL
01690      POP     IX      ;PUT IN IX
01700      POP     DE      ;GET BACK NEW LAST BYTE ADDRESS
01710      INC     DE      ;FIRST FREE BYTE
01720      LD      (IX+0),E  ;AND STUFF IN KIDCB-2
01730      LD      (IX+1),D
01740      ;
01750      ;LOADER:
01760      LD      HL,LOADPOINT      ;INSTALL CODE AT END
01770      LD      DE,(HDRBL)
01780      PUSH    HL      ;GET (HDRBL)+0DCH IN DE
01790      LD      HL,0DCH
01800      ADD     HL,DE
01810      PUSH    HL
01820      PUSH    DE
01830      POP     HL
01840      POP     DE
01850      POP     HL      ;HL= LOADPOINT
01860      LD      BC,27H
01870      LDIR
01880      ;
01890      LD      HL,LOADPOINT1      ;INSTALL 1ST JR INSTR
01900      LD      DE,(HDRBL)
01910      PUSH    HL
01920      LD      HL,09FH
01930      ADD     HL,DE
01940      PUSH    HL
01950      PUSH    DE
01960      POP     HL
01970      POP     DE
01980      POP     HL
01990      LD      BC,2
02000      LDIR
02010      ;
02020      LD      HL,LOADPOINT2      ;INSTALL 2ND JR INSTR
02030      LD      DE,(HDRBL)
02040      PUSH    HL
02050      LD      HL,0FCH
02060      ADD     HL,DE
02070      PUSH    HL
02080      PUSH    DE
02090      POP     HL
02100      POP     DE
02110      POP     HL
02120      LD      BC,2
02130      LDIR
02140      ;
02150      JP      EXIT      ;AND GO
02160      ;
02170      NIST:
02180      LD      HL,NISTMSG      ;DISPLAY MSG
02190      LD      A,@DSPLY      ;AND EXIT
02200      RST     28H
02210      ;
02220      EXIT:
02230      LD      HL,0      ;NO ERROR
02240      LD      A,@EXIT      ;RETURN TO DOS
02250      RST     28H
02260      ;
02270      ;-----
02280      ;
02290      OPMSG:
02300      DEFM    'DO YOU WANT TO FORMAT?  ENTER SAME ANSWER AS ENTERED '
02310      DEFM    'TO TRSDOS MEMDISK.'
02320      DB      0DH
02330      OPMSG1:
02340      DEFM    'THIS PROGRAM ALSO ASSUMES THAT A SSDD TYPE D MEMDISK WAS'
02350      DEFM    ' CHOSEN AS DRIVE #3.'
02360      DB      0DH
02370      OPMSG2:
02380      DEFM    'IT SHOULD ONLY BE RUN IMMEDIATELY AFTER THE INSTALLATION'
02390      DEFM    ' OF THE MEMDISK.'
02400      DB      0DH
02410      OPMSG3:
02420      DEFM    'IF ANY OF THE ABOVE CONDITIONS ARE NOT MET, CHOOSE ABORT!!!'
02430      DB      0DH
02440      OPMSG4:
02450      DEFM    'PRESS Y TO FORMAT, N TO ABORT, OR ANY OTHER KEY TO INSTALL'
02460      DEFM    ' W/O FORMATTING.'
02470      DB      0DH
02480      BUSE:
02490      DB      1
02500      MODNAME:
02510      DEFM    '$MD'
02520      DB      0
02530      HDRBL:
02540      DW      0
02550      NISTMSG:

```

Listing continued

sure of the size. See the Table for the chips used in this project.

You might want to socket the chips to minimize the possibility of heat or static damage. You can do all the wiring on empty sockets and place the chips in them afterward. The actual placement on the boards is a matter of choice. Just make sure that you connect the correct pins to the +5V and ground, and that connections between the chips are as shown on

Installation of a connector of this type frees the edge connector for adding equipment.

the schematics. You can leave unused pins unconnected. You must connect together pin 1 of each of the 256K RAM chips. This requires soldering a wire from socket to socket. You then connect the output of the bank-select board to this wire.

Final Hardware Notes

The signals for the bank-select circuit can be taken off the exterior 50-pin I/O connector. TRSDOS 6.02 leaves the I/O connector enabled. CP/M + and possibly other operating systems disable this port. If the port is disabled, precede any routine that uses the port with a routine that activates the port. The routine must read MODIN (port OFF hexadecimal [hex]), set bit 4, and output the result to MODOUT (port OFF hex). When you are finished using the port, use the same procedure, but reset bit 4, to restore the port to its original condition.

One more comment regarding this connector: If you do not want to use the edge connector, the board has solder holes for a 50-pin internal connector on the same bus. Installation of a connector of this type frees the edge connector for adding other equipment.

Using the Extra Memory

256K Memdisk (see the Program Listing) is a program that patches the TRSDOS Memdisk program to allow it to use the 256K bank of extra RAM as a RAM disk. No other drivers and filters can be in memory when you install the patches, although you can add the drivers and filters after modifying the Memdisk. The reason is that the program takes the first 40 bytes (hex) after the Memdisk and adds them to

Memdisk to hold the patch code.

256K Memdisk alters the TRSDOS tables so that filters, drivers, and other programs that you add later will load correctly, but anything already loaded is overwritten, with interesting results. Therefore, first load the standard Memdisk and then 256K Memdisk at the beginning of your computing session to avoid the chance of a crash.

This program has one deficiency compared to the standard Memdisk: On making a DIR request, the display shows a standard 63K RAM disk, although the free space is shown correctly as 246K (252K minus 6K of system files). The disk correctly adjusts the free space, and other than the directory display, this makes no functional difference.

Guidelines

If you follow the guidelines below, 256K Memdisk should give a reliable performance.

- Always load 256K Memdisk at initial startup, immediately after the standard Memdisk installation and before any other drivers or filters.

- When installing the standard Memdisk, choose a single-sided, double-density, type D (banks 1 and 2) RAM disk as logical drive 3. Any other choices will result in unpredictable results.

- Answer "Y" (do format) to the question the modification program (256K Memdisk) asks.

You should now have a 246/252K Memdisk up and running. You can remove the drive unchanged via the regular Memdisk command.

Reclaiming Data

If for some reason you remove the Memdisk drive and want to reclaim the data on it, you can restore the data, provided you have not turned the power off or run any programs that modify the upper banks of memory.

First, run the regular Memdisk program with the "No format" option. Next, run the 256K Memdisk with the "No format" option (enter any key except "N" or "Y"). You should now be able to access the data.

However, if the original Memdisk was a 64K Memdisk, do not try to use the 256K Memdisk program to reclaim data. If any filters are loaded on top of the standard driver, 256K Memdisk overwrites them, resulting in a crash. Only try to reclaim the upper banks if the original Memdisk was a 246/252K Memdisk.

Inside the Patch

To understand the patch, first consider the 256K of RAM in the upper bank. It is divided into four banks numbered zero to 3 (which I will call XBank) to distinguish them from the standard TRSDOS banks

Listing continued

```

02560      DEFM      'NO DRIVE INSTALLED, EXTENDED INSTALLATION ABORTED.'
02570      DB
02580      ;
02590      ;-----
02600      ;
02610      LOADPOINT:
02620      LD        A,D      ;GET CYL REQUEST IN A
02630      PUSH     BC        ;SAVE BC
02640      LD        BC,0      ;ZERO C(COUNTER FOR NEXT SEC)
02650      ;
02660      LPZ:
02670      SUB      0EH        ;REDUCE TRACK REQUEST MOD 14
02680      INC      C
02690      JR      NC,LPZ
02700      ADD      A,0EH      ;RESTORE A (=CYL COUNT MOD 14)
02710      DEC      C          ;ADJUST BANK COUNT
02720      PUSH     AF        ;SAVE AF
02730      LD        A,C      ;PUT IN A
02740      CP      4          ;CYL REQUEST > 56?
02750      JR      NC,$-85D   ;EXIT WITH ERROR IF SO
02760      NOP
02770      OUT      (0),A      ;THE 2 NOPS ARE JUST SPACERS
02780      POP      AF        ;BRING UP CORRECT XBANK
02790      POP      BC        ;RESTORE AF
02800      ADD      A,A        ;RESTORE BC
02810      ;BEGINNING OF STD CODE (IT AND
02820      ;THE LD A,D WERE REPLACED BY
02830      ;THE JP INSERTED IN THE STD
02840      ;CODE
02850      NOP
02860      JR      $-85D        ;RETURN TO STANDARD CODE
02870      NOP
02880      PUSH     AF        ;SAVE AF
02890      LD        A,0        ;SELECT XBANK 0
02900      OUT      (0),A
02910      POP      AF        ;RESTORE AF
02920      LD        A,102     ;CODE REPLACED BY THE JP
02930      JR      $-55D      ;RETURN TO STD ROUTINE
02940      ;
02950      LOADPOINT1:
02960      JR      $+3DH      ;JP TO PATCH PART 1
02970      ;
02980      LOADPOINT2:
02990      JR      $+31H      ;JP TO PATCH PART2
02990      END      START

```

End

zero to 2). You can map each bank into the space originally occupied by the upper 64K bank of the standard machine. To do the mapping, output the XBank zero-3 to I/O port zero. Select XBank zero at startup and reset it; it is the default bank addressed by the standard Memdisk.

The patch works by taking track requests over 14 (the highest cylinder of the standard Memdisk) and subtracting 14 from them until a number less than 14 is obtained. The number of times 14 was subtracted to obtain the number less than 14 is output to port zero, thus selecting that XBank. Therefore, a request for track 7 brings in XBank zero, the standard bank. A request for track 15 brings in XBank 1, and so on.

Once the correct XBank has been selected, the remainder less than 14 is passed to the standard Memdisk program, which addresses the correct position within the bank. If a cylinder over 56 is selected, a jump is made to the device unavailable exit of the main driver (line 8660 in the code in The Source [Logical Systems Inc., P.O. Box 55235, Grand Junction, CO 81505]). This, however, is unlikely except in custom software, as the GAT (granule-allocation table) and DCT (device-control table) are set for 56 tracks and the only way to make such a request is via machine code. At the end of the standard driver, a section of code brings XBank zero back into context before returning to the calling program.

The setup section alters the DCT and other TRSDOS tables to reflect the Memdisk's new capacity.

The patch code consists of two jumps, which are installed in the driver, and a two-part main patch, which is placed at the end of the driver in the 40 bytes (hex) added by 256K Memdisk. The first jump, line 2940, goes at the beginning of the driver subroutine, which turns a cylinder/sector request into a bank/address request. The code from lines 2610 to 2850 reduces the cylinder-request modulo 14 and translates the deleted cylinders to a request for one of the four 64K XBank formed from the 256K chips. It also maps in the requested bank. It then returns to the standard Memdisk routine, which chooses the correct part of the selected bank. At the end of the standard routine, before restoring the standard memory mapping, another jump is installed (line 2970) going to the second part of the main patch at line 2870. This code simply returns the standard XBank (XBank zero) into context and jumps back to the standard routine. ■

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